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QOS BASED ROUTING PROTOCOLS- A REVIEW

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ABSTRACT

Mobile Adhoc NETwork (MANET) has no central control so communication in this is without any centralized control. Devices are independent to move in any direction. QoS is one of the most rapid growing field as well as a challenging task in MANET due to its dynamic nature. In MANET QoS has become a necessity for providing effective routing techniques. The function of QoS is to satisfy QoS constraints and find the routes from source to destination. There are many parameters in Quality of Services. The importance of QoS is that it helps in implementation of real time applications. Many researches and developments in MANET have been made over past few years and different protocols have been developed with different features. In this paper we have concentrated on QoS models, issues in achieving QoS and comparison of various routing protocols based on QoS and these protocols are defined according to QoS parameters.

KEYWORDS: Mobile Adhoc NETwork (MANET), Quality of Services (QoS), Routing Protocols

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INTRODUCTION

MANET is a set of independent nodes which contains wireless links. It is a self configuring network in which for configuration responsibilities there is no central control [1]. Mobile nodes are free to move in any direction and acts both as host and routers. It is an infrastructure less network which does not have any centralized control. It provides user to access information anytime and anywhere. It helps in maintaining the robustness and efficiency of mobile node. It is of two types Open MANET and Close MANET. In Open MANET different type of networks can communicate with each other so it is considered as heterogeneous MANET where in Close MANET different type of networks can't communicate with each other so this network is considered as homogenous MANET. MANETs have many applications like in search and rescue, civilian environments, crisis management and military environments.

The challenging task in MANETs is to have dynamic routing which imposes routing overheads. Overheads in adhoc are reduced with the help of routing protocols and these protocols are divided into three types.

Table driven protocols are proactive protocols that continuously evaluate the routes so its major advantage is that they require no time for route discovery phase as route is already known. On demand protocols are reactive protocols that are based on route discovery and they generate less traffic overhead as compared to table driven protocol. The combination of reactive and proactive protocols is a hybrid protocol. In this networks are partitioned in zones. When the packets are in same zone then proactive approach [3] is used otherwise reactive approach is used.

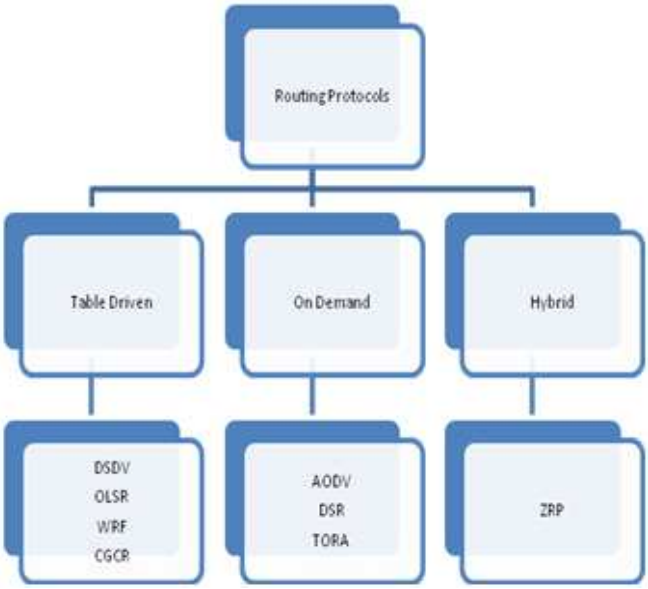

Figure 1: Classification of Routing Protocols

Quality of Service is a service which is fulfilled in transporting the packets from source to destination. It plays an important role in Adhoc networks as it provides the services to the user and applications. QoS mechanism supports an effective routing. Basically it helps in providing the promised services to the user or applications as network has ability to make this service in terms of end-to-end performance. QoS is hard in MANET due to its dynamic nature, limited battery life and limited resource availability. There are two approaches for QoS provisioning soft QoS and hard QoS approach. When the requirements of QoS are not assured for complete session they are soft QoS. When the requirements of QoS are assured for complete session they are hard QoS [4]. Mostly soft QoS approach is used in the protocols. QoS parameters can be concave or additive where bandwidth is considered as concave and delay jitter as additive.

IMPORTANCE OF QUALITY IN MANET

QoS describes the quality of transmission performance. The purpose of quality is to identify and to secure the resources along with routes. Selection of routes is not only based on number of nodes but also on delay, data rate, bandwidth and network life time. Quality is more required in MANET as it helps in implementation of real applications like multimedia audios and videos to guarantee the network in terms of Quality. End-to-end QoS requirements are satisfied in finding a route in routing in terms of delay or performance. In MANET there are many QoS metrics such as delay, jitter, bandwidth, packet delivery, and throughput and so on. Quality is important in MANET as it helps in providing robustness, efficiency, security, performance. It helps in execution of complex processes.

QOS MODELS

QoS models define the services that are provided in the networks in terms of architecture and methodology in spite of protocols or implementation. QoS provisioning architecture is provided by QoS models. There are two types of QoS models on wired networks that are integrated services and differentiated services.

Integrated Services

IntServ [5] provides a virtual circuit on network that helps in communication between source and destination with the help of signaling protocol like RSVP (Resource Reservation Protocol). RSVP helps in maintaining the connections.

Qualitative QoS is provided for every flow in intserv. In intserv services are divided into two class load services. Guaranteed service provides the maximum end to end delay whereas controlled load service provides the reliable and best effort service. Scalability problem in intserv arise due to large size and high speed of the network and due to scalability problem in intserv it is not feasible in MANET as there is a burden on hosts.

Differentiated Services

DiffServ [6] is light weighted model. It uses relative priority scheme. It removes scalability problem by separating the traffic into small number of classes and overcome the implementation difficulty of intserv. Qualitative QoS is provided for aggregated flow in diffserv. This model is designed for high speed and fixed networks. In diffserv services are divided into three classes such as assure and expect forward and best effort. Best effort provides no guaranteed throughput for applications where as assured forwarding provides guarantee and implementation of this service is easy. Expedited forwarding provides a low delay and jitter. It discards the traffic if it exceeds traffic profile. Service Level Agreement is used between provider and user to use the diffserv.

There is a hybrid of intserv and diffserv models that utilize the functions of intserv and diffserv and it is FQMM. SWAN is a stateless model and this is for wireless networks.

FQMM

FQMM is Flexible QoS Model for MANET [8]. In this per flow QoS is used for high priority flow and aggregate QoS are used for lower priority flow. There are three types of nodes in this model that have multiple roles. Ingress Node sends the data that means it acts as a source node and it is responsible for traffic shaping. Interior Node forwards the data from one node to another node and Egress Node acts as a destination node that receives a data. If the size of network is increased then it causes the scalability problem and increases the complexity of node with the cost of per flow state management.

SWAN

SWAN is Service Differential in Stateless Wireless Adhoc network [8]. It delivers services in simple, robust and scalable manner due to its stateless nature. It is a stateless network model so there is no need to maintain states at immediate nodes and two messages can be sent simultaneously with both receiving result from the available resources. It is based on reservation less approach. Bandwidth and delay is maintained in this model. In quick succession if protocol occurs multiple times then it cause large jitter and latency and if there is frequent flow reestablishment then there is high signaling problem.

ISSUES IN PROVIDING QOS IN MANET

Traditional wired networks have different perspective as compared to that of wireless networks like MANET. In MANET it is difficult to provide QoS due to many characteristics such as node mobility, unpredictable link property, security, route maintenance and limited battery life. These are defined as follow.

Node Mobility

Due to the dynamic nature of node it creates mobility. Links are separated in dynamically formed networks when nodes move out of the transmission range.

Unpredictable Link Property

We can't predict the links in wireless network as packet collision is natural in these networks. This causes interference, fading of signals and cancellation of multipath due to which bandwidth and delay measures become unpredictable.

Security

Security is considered as one of the main attribute of QoS as it provides authorized access. In case of broadcasting and communication through physical medium security is unprotected so security based routing protocols must be designed for MANET.

Route Maintenance

When the data is transferred the established paths may be broken. In network nodes can be joined or leaved at anytime which requires maintenance of paths.

Finite Battery Life

Generally devices are based on battery source. These sources are finite. For utilization of resources rate of battery consumption and residual battery power must be considered for QoS provising.

QOS ROUTING PROTOCOLS

Best routes are discovered with the help of QoS routing to meet the end-to-end QoS requirements. Due to dynamic nature of topologies QoS routing is difficult in MANET. The information of topologies must be maintained at the nodes of MANET to help QoS routing if this is not maintained then performance of QoS routing is degraded. In case of path breaks QoS routing protocols must respond quickly and bypass the broken links and recomputed the broke paths without affecting QoS. To improve performance numbers of on demand routing protocols have been proposed. These are defined as follow.

CEDAR

Sivakumar and Raghupathy proposed a CEDAR. It is Core Extraction Distributed Adhoc Routing [9] and is for the small to medium sized network. The network's core is dynamically established in this routing protocol that makes the links stable and maintains high bandwidth. Low overhead and efficient infrastructure is provided by core to perform broadcasts and routing in MANET. For route computation only local state is used at each core node and it is robust in nature. Re-computation of routes is done in CEDAR when the links fails. CEDAR is divided into three components.

Core Extraction: The core is collection of nodes and they are elected dynamically and distributed to minimize the dominating set of networks. To maintain the local topology of nodes a core is formed by a set of nodes and route computation is performed on its domain.

Link State Propagation: Stable high bandwidth links and local topology is maintained to achieve the QoS routing and there information is known to the core nodes while for dynamic and low speed links the information is kept local. A change in available bandwidth is denoted by slow moving increase and fast moving decrease waves.

Route Computation: In this neighboring core node establishes a path with core node. The requested bandwidth is satisfied in the core path by finding the partial routes iteratively directional information is used. To perform routing in

CEDAR low overhead infrastructure is provided by core.

OLSR

Jacquet, Mühlethaler and Clausen proposed an Optimized Link Stable Routing protocol (OLSR) [10] which is used to find large bandwidth routes by using MRP multipoint relays. Data packet transfer over unidirectional links problem is avoided by MRP. For route selection and route discovery MRP acts as intermediate router. This routing protocol is proactive in nature. It minimizes the overhead by reducing the broadcasts messages. The size of broadcast messages is reduced by making small subsets of its neighbors. When routes are required they are immediate available as it is proactive in type. The disadvantage of this protocol is that it may not discover the shortest path so it is more suitable in dense and large networks. In this rerouting is possible for the degraded routes. There are three main functions of OLSR is forward packets, sense the neighbor and discovery the topology and four message types are used. These are Multiple Interface declaration, Topology Control message, Host and Network, and Hello message. Optimized ways to flooded messages are offered in networks using MRP and provide neighbor's information in case of packet forwarding and neighbor sensing. Local information is diffused by routers for whole network in case of neighbor sensing. The topology of entire network and calculations of routing table is determined by topology discovery.

TBP

Shigang Chen and Nahrstedt proposed Ticket Based Probing routing protocol (TBP) [11] which is a multipath routing scheme in which source and destination issue the search message with the help of tickets. Availability of state information is known by number of tickets as tickets issued from source give the maximum number of searched paths. To find possible paths certain number of tickets is sent by source node that can be delay or bandwidth constrained. Yellow and green ticket is used in this protocol. For finding a route along with bandwidth or delay constrained yellow ticket is used and for low cost route determination green ticket is used. Path redundancy, rerouting and path repairing is possible in this routing. This protocol requires more memory to keep complete information about each neighbor.

GAMAN

Barolli and Suganuma proposed GAMAN. It is Genetic Algorithm based QoS routing protocol used in MANET [12]. For QoS parameters it uses transmission success rate and end to end delay. To provide an optimal solution for finding an optimal route it is done using genetic algorithm by two QoS constraints such as gene coding and fitness value. This method is not applicable for large networks because to collect information many paths have to be searched.

PLBQR

SH Shah and KlaraNahrstedt proposed PLBQR [13]. It is Predictive Location Based QoS Routing which is used to predict the location delay as it is a location aware protocol. It performs location resource update protocol and the information of the node is updated using this update protocol. As the degree of mobility of nodes is high then there is a dynamic change in resource availability and in topology. In this protocol prediction of new location is done easily but in case of dynamic changes in direction accurate prediction is not possible. A loop free path is provided from source to destination and it is robust in nature but velocity and direction is not predicted accurate due to its dynamic nature.

QMRPD

S Chen, K Nahrstedt and Y Shavitt proposed QMRPD [14]. It is QoS Multicast Routing Protocol. It is based on dynamic group topology which is used to reduce overhead of multicast tree and is a hybrid routing protocol. It fulfills the lower cost requirements and multiple QoS constraints. The main objective of this protocol is that it makes effective use of network resources and optimizes the constructed multicast tree as well as decrease the overall cost of the tree with constraints related to performance like minimum bandwidth, bound delay, maximum packet loss probability and delay jitter bound. This protocol handles less message processing overhead for dynamic group members.

AQOR

Q Xue and A Ganz proposed AQOR [15]. It is Adhoc QoS On demand Routing which is used to estimate the delay and bandwidth reservation along with route recovery. To guarantees QoS reservation oriented method is used to discover the available best route by using limited flooding. The flow of bandwidth reservation is made activated when there is arrival of first data packet but these reservations are temporary. During route discovery delay is measured and source chooses the route with least delay. When QoS violation occur then routes then routes does not maintain redundancy for fast recovery. Due to temporary nature of reservation there is no need of tear down connection.

CONCLUSIONS

In this paper QoS models, issues in achieving QoS and comparison of routing protocols based on QoS were reviewed. The importance of quality is to identify and to secure the resources along with routes. QoS helps in implementing the real time applications. There are many issues in achieving QoS in MANET like node mobility, unpredictable links, and route maintenance and so on. These must be removed to improve the performance. The performance is improved with the help of various protocols that have been developed. On demand routing protocols have been discussed in this paper. We have defined these protocols according to different approaches like QoS parameters, Network Architecture, Mobility, Addressing Route discovery, Density and Route redundancy. These protocols have included only one or two QoS parameters to provide the solution for routing so there must be new protocols that include mathematical formulation and all the other parameters like jitter, throughput, end to end delay and packet loss.

Table 1: Comparison of Routing Protocols

Routing Protocols	QoS Parameter	Network Architecture	Mobility	Addressing	Route Discovery	Density	Route Redundancy
CEDAR[9]	Bandwidth	Hierarchy	Medium	Unicasting	Proactive/ Reactive	Medium	No
OLSR[10]	Bandwidth	Hierarchy	Low	Multicasting	Proactive	Low	No
TBP[11]	Bandwidth/ Delay	Flat	Low	Multicasting	Reactive	Low	No
GAMAN[12]	Bandwidth/ Delay/ Packet Loss	Hierarchy	Low	Multicasting	Reactive	Medium	No
PLBQR[13]	Bandwidth/ Delay	Location Prediction	Medium	Unicasting	Proactive/ Reactive	Medium	No
QMRPD[14]	Bandwidth/ Delay/ Jitter/ Cost	Hierarchy	Medium	Unicasting	Reactive	Low	No
AQOR[15]	Bandwidth/ Delay	Flat	Medium	Multicasting	Reactive	Low	No

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